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XXVI. *Experiments on the Peruvian Bark,*
by Thomas Percival, M. D. F. R. S.

EXPERIMENT I.

Read March
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AN ounce of Bark coarsely powdered was divided into two equal parts, one of which was infused forty-eight hours in cold spring water ; the other was boiled over a slow fire forty minutes, until about a third part of the water was evaporated. The infusion and decoction were each filtered through linnen rags doubled and of equal fineness.

Four grains of *Sal Martis* were dissolved in an ounce of spring water, and one dram of this solution was added to equal quantities, viz. half an ounce ; of the turbid decoction and infusion. Each assumed a deep purple colour, scarcely perceptibly different in degree ; though I thought the infusion, after standing a while, acquired rather a more dusky purple than the decoction.

The infusion had a deeper tinge, and more of the taste and smell of the Bark in substance than the decoction. Its taste indeed exactly resembled the Bark, after it had been broke down and chewed for some time in the mouth.

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EXPERIMENT II.

Equal quantities of each residuum were boiled in three ounces of spring water over a slow fire, for the space of twenty minutes. The decoctions were equally turbid, exactly similar in taste; and on the admixture of the chalybeate solution in the proportion of one dram to half an ounce, they assumed precisely the same colour, namely a dusky brown, like chocolate, but inclining somewhat to purple.

EXPERIMENT III.

Five ounces of each residuum were infused, for the space of forty hours, in an ounce and a half of Jamaica rum, which was sufficiently pure, and unimpregnated with any astringent matter from the cask. The tinctures were exactly alike in taste and colour; and on the addition of one dram of the chalybeate solution, they were instantly changed from a deep red, to a dark and dirty brown; which was precisely the same in both tinctures.

EXPERIMENT IV.

To half an ounce of powdered Bark, was added an ounce of cold spring water. The mixture was well triturated in a marble mortar, after which it was suffered to remain at rest until the gross powder subsided. The clear liquor was then carefully poured off, and fresh water to the quantity of half an ounce was added; the trituration was renewed, and afterwards part of the menstruum poured off again as before. This method was pursued for the space
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of thirty-four hours, in which time six ounces of water were combined with the Bark. The mixture was then infused fourteen hours without heat, and strained off. This infusion was found to have the smell and taste of the Bark, in a considerable greater degree than either the decoction or infusion without trituration of Experiment I. and it assumed a much blacker colour, on the admixture of one dram of the chalybeate solution, than either of the two former preparations.

EXPERIMENT V.

It was attempted to determine the comparative strength, or rather astringency, of five preparations of the Bark, viz. the extract, decoction, cold infusion, tincture and triturated infusion. Ten grains of the extracts carefully made, and as free from empyreuma, as this officinal preparation is generally found to be, were mixed with an ounce of hot water. But so imperfect was the solution, or, to speak more properly, the suspension of the Bark, that in a few minutes a large powder was deposited at the bottom of the glass. This however was shaken up, and one dram of the chalybeate solution was added to the mixture. The same quantity was added to half an ounce of the decoction, infusion, tincture, (Pharm. Lond.) and triturated infusion; the last assumed by far the deepest black; the extract approached nearest to it, and the tincture appeared to be the least tinged. The decoction and infusion were precisely alike in colour.

EXPERIMENT VI.

The residuum of the triturated infusion, Experiment IV. was boiled over a slow fire in three ounces of water, for the space of twenty minutes. The decoction when cold was strained off, it was of a paler colour than the decoctions mentioned Experiment II. although there was a portion of powdered Bark, suspended in it, which, by the trituration, had been rendered fine enough to pass through the filter. This powder, on standing, subsided to the bottom of the vessel, and left the decoction much more limpid than it was before.

To equal quantities of this, and of the two decoctions mentioned above, one dram of the chalybeate solution was added ; the black tinge was manifestly weakest in this decoction, though the difference was not so great as might have been expected, from the diversity in their sensible qualities of taste and smell ; owing perhaps to the fine powder of the Bark, which floated in it, and retained some degree of its original astringency.

EXPERIMENT VII.

Equal quantities of the simple and triturated infusion were boiled for the space of seven minutes over a quick fire ; both lost their transparency when cool ; but the latter assumed a much more turbid appearance than the former, exceeding even that of the decoction from fresh Bark, Experiment I. and, after standing twenty-four hours, it deposited a very copious sediment.

EXPERIMENT VIII.

Half an ounce of powdered Bark was infused forty-eight hours in five ounces of spring water, and one ounce of white wine vinegar. The mixture was placed near a warm fire, and frequently shaken up. It was then filtered through a linen rag doubled. The taste of the vinegar was in a good measure covered, though the smell was not; but the menstruum was not so fully impregnated with the flavour of the Bark, as the infusion Experiment I. One dram of the chalybeate solution was added to this acid infusion. At first no change of colour took place, but in a few hours a slight black tinge appeared.

EXPERIMENT IX.

Half an ounce of powdered Bark was well triturated, in the manner described in Experiment IV. with six ounces of warm water, after which the mixture was poured into a bottle, placed near a fire, and frequently shaken up. This process lasted forty-eight hours. The infusion, when strained off, was found to be more perfectly impregnated with the Bark, than the triturated infusion in cold water, Experiment IV. as appeared by comparing their colour, taste and smell, and by the deeper black which it instantly assumed on the admixture of one dram of the solution of *sal martis*.

EXPERIMENT X.

Half an ounce of powdered Bark, and two drams of stone quick-lime, warm from the kiln, were
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rubbed together till they were thoroughly united ; then 6 ounces of spring water were gradually poured on, the powder and the water were well incorporated by triture, and the mixture was set by to infuse for twelve hours. Two ounces of it were then filtered through a double linnen cloth, the remainder stood thirty-six hours longer ; and was frequently shaken up, after which it was strained off. The smell of the Bark was almost entirely covered in both the infusions, which were strongly impregnated with the lime ; and had an extremely disagreeable flavour. The first was of a pale colour, and possessed but a slight degree of bitterness ; the latter had a deeper tinge, and was equally bitter and nauseous. Neither of them struck a black colour with the chalybeate solution, which, as soon as it was added, occasioned a yellow sediment, that in a few hours subsided to the bottom of the glass. Compared with the triturated infusion Experiment IV. these preparations appeared to be much weaker both in colour and taste. The residuum did not sensibly effervesce with oil of vitriol.

EXPERIMENT XI.

The decoctions and infusions were found to be impaired in strength, after standing six or seven days, though it was the winter season, and the weather was severely cold ; the infusions became paler coloured, and at the same time deposited a slimy sediment. The decoction, at the end of seven days, assumed almost a milky hue, and struck but a faint black with the chalybeate solution. The simple infusion also

had lost much of its astringency; but the two triturated infusions were very little altered in that respect.

Remarks on the preceding Experiments.

PHYSICIANS in general agree, that the Peruvian Bark is most powerful in its effects, when taken in substance. But as the stomach is frequently unable to bear it, and as many patients have almost an invincible aversion to it in that form; it is of importance to determine in what preparations the virtues of this valuable drug are least impaired; and whether it may not be administered, under a form that is elegant, palatable, and at the same time sufficiently efficacious. The decoction of the Bark, has always appeared to me an injudicious preparation, for, though the cortex is not a substance of much volatility, yet there is a certain aroma accompanying it, which the heat of boiling water cannot fail to dissipate; and consequently the medicine is deprived of one of its component parts, in which probably some of its virtues reside. The Bark likewise undergoes a decomposition by boiling, the resin is separated from the gum, and remains suspended in the watery menstruum. This renders its appearance inelegant, its taste nauseous; and, I should apprehend, must considerably diminish its efficacy. For as the virtues of the Bark are strongest in its native state, they depend in all probability on its composition as a mixt; and must of course be impaired, by the disuniting of its constituent principles. By the first, second, and third, Experiments, it appears, that the

cortex yields its virtues at least as perfectly to cold, as to boiling water; and the simple infusion hath certainly many advantages over the decoction. It is a much more agreeable and elegant preparation, and the principles of the Bark remain perfectly unaltered in it, retaining the same proportions to each other, as in the substance of the drug itself. Nature hath so accurately combined and blended together the gummy and resinous parts of the cortex, that by their union they become soluble in menstrua, with which when separate they refuse to unite. Thus they reciprocally promote the solution of each other, in water and ardent spirits; and both the tincture and infusion are found, by Experiment, to be strongly impregnated with these two constituent principles of the Bark. The tincture is, without doubt, an elegant and palatable preparation; but it is liable to this objection, which indeed hold equally true against spirituous tinctures in general: that a sufficient dose of the medicine cannot be taken, on account of the heating nature of its vehicle. In low nervous fevers, hysterical disorders, and other cases where it is necessary to join cordials with the Bark, an infusion of it in red port may be prescribed with advantage. Under this form the empiric Talbot used to administer the cortex, in the paroxysms of intermittents; and so successful was his practice, that Lewis the XIVth was induced to purchase, at a large price, the secret of his specific. Orange peel is an useful ingredient, in preparations of the Bark; it gives a grateful warmth to the infusion, and adds, I think, considerably to its efficacy. The following formula is agreeable to the taste,

taste, and well adapted to a weak and delicate stomach.

℞ Pulv. Cort. Peruv. ℥j
 Cort. Aurant. incis. ℥ss
 Aq. Cinnam. ten. ℥xij
 Aq. Cinnam. spir. ℥ij M. f.

Infusio in vase clauso, sine calore, per sesquidiem,
 deinde coletur.

The use of trituration, in promoting the powers of solution, is evident from Experiments IV. VI. and VII. and would have been still more so, if a proper apparatus had been employed. The Count de la Garaye, a French gentleman, who is distinguished for his assiduity in applying the different branches of philosophy to the improvement of medicine, has described a very convenient machine; and pointed out an admirable process for obtaining from vegetables, by triture with water, the matters in which their virtues chiefly reside. The contrivance is extremely simple, consisting only of a vessel, to which a churning staff is fitted, which, by means of a wheel, and a cord, is perpetually whirled round with a rotatory motion. By this constant agitation, the most accurate diffusion is produced; and different portions of the menstrua are in quick succession applied to every part of the solvent.

From the Vth Experiment, no certain conclusions can be deduced; except that the extract is a much weaker preparation than is commonly supposed. It is liable to all the objections, which have been advanced against the decoction; with this additional one, that it

it is hardly possible to make it, according to the process of the London dispensatory, without giving it some degree of empyreuma. The extract employed in my experiment was prepared by a very diligent and careful apothecary; yet a considerable portion of it presently subsided in a powdery form to the bottom of the glass, which on examination appeared to be the burnt parts of the Bark. How little then is this officinal preparation to be depended upon, when we consider the carelessness and inaccuracy of the generality of apothecaries!

It is the practice of the most eminent physicians, to join acids with the Bark, in the cure of putrid diseases; and Sir John Pringle has observed, that in bilious fevers the cortex answered best in rhenish wine, after standing a night in infusion^a. This suggested to me the VIIIth Experiment and I flattered myself, that by macerating the Bark in a mixture of vinegar and water, these two antiseptic medicines would be more accurately combined together; and that perhaps the acid might promote the dissolving power of the aqueous menstruum. In the latter expectation it appears that I was disappointed; and whether the former was better grounded, must be left to abler judges to determine. The result of this Experiment was so contrary to my expectations, that I determined to make further trials of the effects of vinegar in destroying that property, in certain vegetable substances, by which they strike a black colour with chalybeates, which has been long regarded as an almost indubitable test of astringency.

^a Diseases of the Army, Edit. iv. p. 213.

An ounce of the infusion of chamomile flowers, was divided into two equal parts; to one was added a dram of white wine vinegar, to the other an equal quantity of spring water. Thus, with respect to dilution, they were precisely in the same circumstances; a tea spoonful of the *sal martis*, was then mixed with each of them, the portion which contained the vinegar, suffered no change of colour; the other instantly assumed a dusky hue. The same Experiment was repeated, with a very strong triturated infusion of the Bark; and the result was still more singular and curious. As soon as a dram of vinegar was added to half an ounce of the infusion, it changed the colour of it, from a deep and reddish brown, to a bright yellow; whilst the same quantity of water had no sensible effect on the other portion with which it was mixed. The chalybeate solution, as in the former Experiment, was then added. It produced no alteration in the portion with vinegar, but the other was changed into a perfect ink.

That moderate heat promotes and assists the action of water, as a menstruum on the Bark, is evident from the IXth Experiment; and it would be of advantage to determine, what degree of heat this drug will admit of, without suffering a decomposition. It should however be remarked, that this infusion though stronger, had neither so agreeable a flavour, nor was so sensibly impregnated with the aroma of the Bark, as the two made with cold water.

In an essay on the dissolvent power of quick-lime, a very ingenious chemist has observed, that all resinous bodies become soluble in water, when the cohesion of their particles is destroyed, by withdrawing the
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the fixt air which they contain. This method of solution he endeavours to apply to many valuable purposes in medicine, and hath described several useful and curious processes for obtaining strong and elegant tinctures of the most active drugs, by means of quick-lime. The first part of the Xth Experiment, *mutatis mutandis*, was borrowed from him; and it was hoped, that an efficacious and palatable infusion might with tolerable expedition be made, by the process which he has laid down. But the success of my Experiment was by no means answerable to the plausibility and ingenuity of the theory, which induced me to attempt it. The infusion, after standing twelve hours, the time prescribed by Mr. Mc'Bride, was but weakly impregnated with the Bark; and when the maceration had been continued forty-eight hours, it by no means equalled in strength the preparation described Experiment IV. It appears therefore that quick-lime, whatever its effects may be upon other medicines, neither quickens nor increases the solubility of Bark in water; and it communicates to the infusion a taste which is intolerably nauseous and disagreeable. That the chalybeate solution should produce no change in the colour of these preparations, is agreeable to the laws of elective attraction. For the acid of vitriol, having a stronger affinity with absorbent earths than with metallic substances, forsakes the iron with which it was combined, and unites itself to the quick-lime. Hence arose the yellow ochry sediment, taken notice of in the Experiment. As the residuum, after filtration, did not effervesce with oil of vitriol, it is evident that quick-

quick-lime is not endued with the power of abstracting from Bark the fixed air which it contains.

Experiment X. furnishes no other inference than this obvious one, that the decoction and infusion of the Bark are calculated only for immediate use. The cortex is a substance of a very fermentable nature, as appears from the Experiments of Mr. M'Bride; and when its active parts are diffused in water, and separated from those which are merely ligneous and inert, it is not to be wondered at, that it undergoes those changes, to which all vegetables, when favourably circumstanced, are liable.

Warrington,
February 1, 1767.

Thomas Percival.